MULTIMEDIA UNIVERSITY

STUDENT ID NO

MULTIMEDIA UNIVERSITY

FINAL EXAMINATION

TRIMESTER 3, 2017/2018

TIC2151 THEORY OF COMPUTATION

(All sections / Groups)

6th JUNE 2018
2:30 pm – 04:30 pm
(2 Hours)

INSTRUCTIONS TO STUDENTS

1. This Question paper consists of 4 pages only excluding the cover page.
2. Attempt All questions. The distribution of the marks for each question is given.
2. Please write your answers in the answer booklet provided. Please write the question number of each answer clearly.

QUESTION (1)

NOTE: Attempt any THREE out of FOUR Parts (A), (B), (C) and (D).

(A)

1. Prove the following by construction: [3 marks]

   "For any integers **a** and **b**, if **a** or **b** is even, then **ab** is even".

2. The NFAs are defined in the same way as DFAs but with two main exceptions, what are these exceptions? (explain briefly) [2 marks]

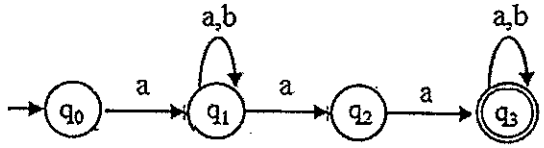
(B) Draw state diagrams for DFAs accepting each of the following languages:

$L_1 = \{w \in \{0, 1\}^* \mid w \text{ is the set of strings that start with } 010\}$ [2.5 marks]

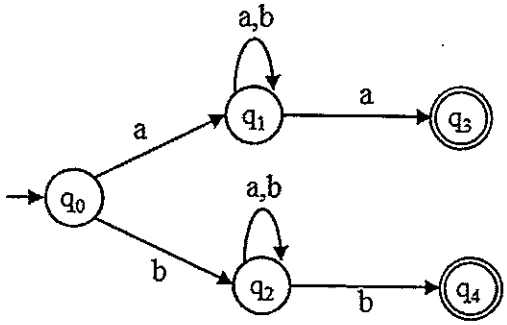
$L_2 = \{w \in \{a, b\}^* \mid w \text{ has neither } aa \text{ nor } bb \text{ as a substring}\}$. [2.5 marks]

(C) Draw the state diagram for DFAs accepting the same languages as the following NFAs. [5 marks]

1)

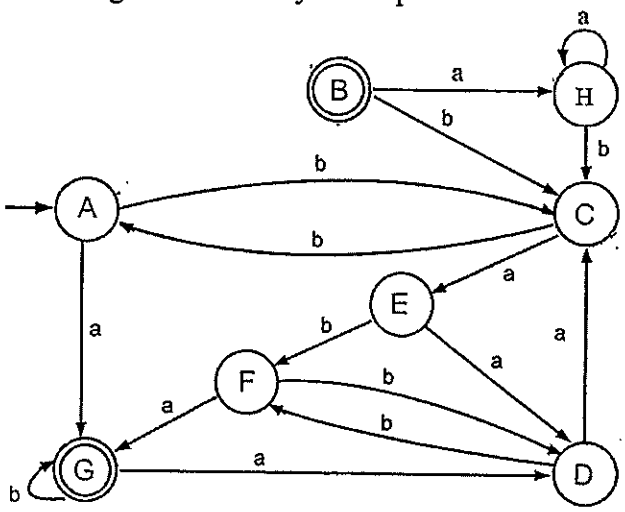


2)



(D)

Minimize the following DFA. Show your steps. [5 marks]



QUESTION (2)

(A)

1. Determine the language corresponding to each of the following regular expressions:

   i. $((a + b)\ (a + b)\ (a + b))^*$ [1 mark]

   ii. $a(a + b)^+b + b(a + b)^+a$ [1 mark]

2. Find regular expressions corresponding to each of the following languages. [3 marks]
   i. L={ w∈{0, 1}* | String w is of even length}
   ii. L={ w∈{0, 1}* | w contains at most two 0's. }
   iii. L={ w∈{0, 1}* | String w contains no more than one occurrence of the string 00}.

(B) Convert the following regular expressions into an NFA. Follow the construction rules closely and do not just give a simpler NFA even though it is possible. [5 marks]

$(01)^*(0 + 1)^*0$

(C)

1) Convert the following regular grammar into an NFA. [3 marks]

S => a | bT | ε
T => bT | cQ | bb
Q => aaQ | cc | aT

2) Give the regular grammars corresponding to each of the following languages over the alphabet {0, 1}.

L_1 = { w | w ends with 11 or 00 } [1 mark]
L_2= 0 (101)* 1 [1 mark]

Continue...

QUESTION (3)

(A) Construct a PDA over the alphabet {a, b, c} for each of the following languages:

$L_1 = \{a^n b^{3n+1} c \mid n > 0\}$ [3 marks]

$L_2 = \{a^2 b^n c^n \mid n >= 1\}$ [3 marks]

(B) The following CFG grammar is in Chomsky normal form. Use the Cocke- Younger-Kasami (CYK) algorithm to determine whether the word *aabbabbb* can be derived from this grammar or not. Show your proof. [4 marks]

B => BB | XA | XY

A => BY

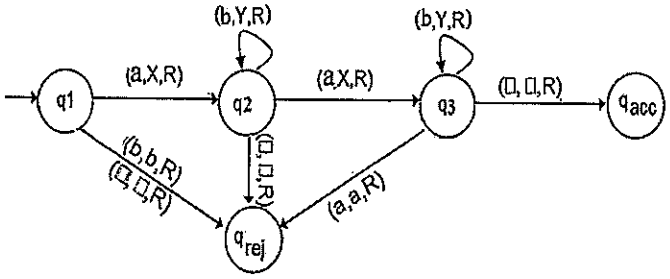
X => a

Y => b

QUESTION (4)

NOTE: Attempt any TWO out of THREE Parts (A), (B) and (C).

(A) Given the following Turing Machine:



1) What language does the machine accept? Give the language in regular expression form. [2 marks]
2) Give the formal definition of the machine. [3 marks]

(B) Construct a Turing Machine for the language $L = \{a^n b^n c^m \mid m, n \geq 1\}$. [5 marks]

(C) Given the following two languages:

$A_{DFA} = \{\langle B,w\rangle \mid B \text{ is a DFA that accepts input string } w\}$.

$A_{NFA} = \{\langle C,w\rangle \mid C \text{ is a NFA that accepts input string } w\}$.

A_{DFA} has been proven to be a decidable language. Prove that A_{NFA} is a decidable language as well. [5 marks]

End of page.